

Highway Materials Research Laboratory  
132 Graham Avenue, Lexington, 29, Ky.

December 13, 1949

D.2.1  
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Memo. to: Dean D. V. Terrell  
Director of Research

Re: Study of Acid Water Conditions in Kentucky

On October 4, Mr. Bray wrote to you regarding a memorandum which had been prepared a few days prior to that time reporting on some unusual water conditions on the newly constructed portion of U. S. 60 between Grayson and Ashland. The Division of Design had expressed concern over the very early disintegration of the invert of an uncoated corrugated metal pipe in one or two locations on that project, and had suggested that the Research Laboratory look into this if conditions permitted.

Accordingly, J. H. Havens, Research Chemist, went to these locations about the middle of September, sampled the water on both sides of the road at one point of interest, tested this water in the laboratory, and prepared the memorandum which is attached. This is the report to which Mr. Bray made reference in his letter of October 4.

In commenting on the report Mr. Bray stated that the location described was "... an unusual condition and one that probably no advance investigation of ground water quality would have anticipated; however, it should be possible to define by proper investigation certain general geographic areas of the state in which acid ground waters are likely to be prevalent". He then expressed an opinion that the Department may be making a mistake in continuing to specify uncoated corrugated metal pipe for road construction and maintenance in those sections, and recommended that a study of these conditions be made if we thought it worthwhile.

A project for this purpose has been established, and some preliminary work has been done. We are now in a position to expedite this, but in order to approach it most intelligently and efficiently there are two things which we should know.

1. The localities where the information is most urgently needed in order that effort can be concentrated on those areas. These may be areas in which grade and drain projects will

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be set up in the very near future, and a decision on the pipe must be made soon.

2. The localities where disintegration of the pipe has been prevalent in the past. Probably this information could be supplied best by the District Engineers, with some additions by the various Divisions involved in the Central Office.

Considerable advance study and compilation of data is necessary on a project having such a broad geographical scope as this, in order to avoid wasting a lot of time and effort before we become oriented. However, if information for some localities should be expedited, we can give attention to those immediately. That is the principal reason for this memorandum and the scheduling of a discussion of this at the Research Committee meeting on December 20.

Incidental to this, but still of primary importance, is the use we intend to make of aerial photographs whenever they are available. By this means we will not only be able to view the watersheds and evaluate soils to the extent that that is possible, but also we should be able to establish some natural as well as unnatural features (such as mining operations) which contribute to or determine the acidity of runoff waters. In instances where photographs are not available in the Highway Department files in Frankfort -- and that will be the rule rather than the exception since the Department has relatively few photographs scattered throughout several counties -- we may have temporary access to them in the county offices of the Production and Marketing Administration. Thus far we have been able to look at Photo Index Maps for most counties in their State Office here in Lexington, but they have only a few of the contact prints which are at a scale usable for our purpose.

This use, plus the many other uses that have been made of aerial photographs in other operations throughout the Department, accentuates the value of these photographs and the fact that we have only a fraction of those that have been taken in all but four or five counties of the state. It may be that plans are underway for the Department to enlarge greatly on the aerial-photo coverage soon; but if that is not the case, I think the matter deserves a lot of consideration.

We will proceed with this interesting and worthwhile study of acid water conditions both in the field and through laboratory

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tests to determine comparative effects of such water, on the various kinds of pipe used in highway work. I am certain that the results will be unique as well as useful.

Respectfully submitted,

  
L. E. Gregg  
Associate Director of Research

LG:vk

Attachment

Copies to: Research Committee Members  
Mack Galbreath

Highway Materials Research Laboratory  
132 Graham Avenue, Lexington, 29, Ky.

September 21, 1949

D.2.1

Memorandum to: Mr. L. E. Gregg  
Associate Director of Research

Re: Erosion of Longitudinal 40" Corrugated  
Metal Pipe, 1-1/2 Miles Northeast of  
Princess, Kentucky, on U. S. 60

Several days ago you expressed an interest in circumstances at the above installation which brought about the erosion of the floor of culverts on the north side of the road while similar installations on the south side remain unaffected after approximately one year of service. Because the apparent circumstances were seemingly unique, Mr. Peed and I visited the location and made an inspection of the existing conditions in an effort to explain this premature disintegration.

We found, from the inspection of the surrounding terrain that the grade of the road acts as a divide -- that is, the drain on the north side of the road drains only the area on the north, while the longitudinal drain on the south drains only the area on the south side. We also found, as you described, that longitudinal culverts on the south side were still in good shape while those on the north side had lost, by erosion, about two feet of the lower arc which had been continuously washed by the drainage water. Photographs of the installations and conditions described are attached hereto.

Further inspection of the locale revealed that extensive "strip mining" operations are being "carried on" on the north side. We traced this drainage water to within approximately a thousand yards of the mining operations where the drain left the road and went up a "hollow" in the direction of the mine.

We made a local inquiry and found that these mining operations are being conducted by a Mr. Yates who has offices in Princess. Our informer also related that several years ago tunnel mining was very extensive on the southside and that after the mines were abandoned, their drainage water contaminated the streams to such an extent that some governmental agency sealed them up; and although they still drain, are sealed from the atmosphere which reduces the formation and solution of corrosion acids and salts. In that regard, it is my opinion that continuous

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excavation producing new exposures for solution and drainage would result in extreme contamination.

Samples of drainage water were taken from both sides of the road and brought to the laboratory for analysis.

Results of Analysis:

The acidity of the water on both sides was titrated using NaOH and the concentration of acid was calculated in terms of the acid equivalent of the base necessary to bring about neutralization:

North side - .01019 equivalents per 1000 cc  
South side - .000238 " " " "  
These equivalents calculated in terms of  $H_2SO_4$ :

North side - - .499 gms.  $H_2SO_4$  per 1000 cc.  
South side - - .0117 gms.  $H_2SO_4$  per 1000 cc.

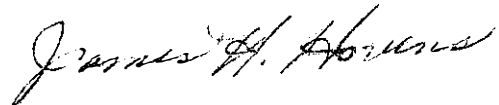
Analysis for chlorine ion concentration:  
North side - - .000217 equivalents per 1000 cc.  
South side - - trace only

Barium precipitate:  
North side - - 5.18 g. per 1000 cc.  
South side - - .942 g. per 100 cc.

$H_2SO_4$  equivalent of Barium ppt:  
North side - - 2.18 gms. per 1000 cc.  
South side - - .396 gms. per 1000 cc.

The results above are sufficient to explain the difference between the samples of drainage water and to explain the corrosion or erosion of the culverts on the north side of the road.

No further investigation will be directed to this matter except on request.



James H. Havens  
Research Chemist

JHH:vk



No. 1. Close-up of bottom of culvert on the north side of road. It can be seen that the bottom of the arc is missing and the water now flows at a depth of about 3" below the original pipe.

No. 2. General view of Culvert on south side of road showing Mr. Havens obtaining sample of the water. Culverts on this side show only slight corrosion and water still flows through them normally.

